
REPORT
OF THE
ROAD SURVEYOR
ON THE
DRAINAGE
OF THE
CITY OF QUEBEC.

Presented to the Council on the 5th of
March 1852.

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ROAD SURVEYOR'S OFFICE,
Quebec, 3rd February, 1852.

Pursuant to a resolution of the Council, dated 9 May 1851, requesting the Road Surveyor to report on the best mode to be adopted to carry out a general system of canalisation in the City of Quebec, in connexion with the excavations to be made for the aqueduct, which are to be commenced next spring, he has the honor to present to your Council the following report.

Before entering into the details of an estimate, it becomes necessary to consider the system of drainage followed in England, and to establish a comparison between the cost of drains there, and those made in Quebec, in order to adopt the most economical method, and also, that most in accordance with the means of the City; guarantying thereby, the execution of this noble enterprise, by meeting the general approbation of the Citizens.

The drainage of cities and populous towns, is always made with the view to desiccate the soil and to promote the local comfort of the citizens, by affording them the facility of ridding their houses and premises of foul water and night soil, by means of drains leading into the sewers.

But in order to attain this end, the mode to be adopted ought to be made as economical as may be consistent with the object in view, and the cost of private drains should not exceed the means of the proprietors; otherwise, it might happen here as it did in England, where, in almost every Town, it was found that private drains

only occurred once in every 200 feet, because the proprietors could not afford to pay the charges thereto attached, such as the drain rate, the Town fee and the cost of the drain itself.

Drains and sewers are generally constructed of brick, in England and in other old countries, it being the cheapest and the most convenient material which can be used for this kind of work. They were originally made flat bottomed and with perpendicular sides; fig. 1, next with curved bottoms, fig. 2; but the new form is oval, fig. 3.

The perpendicular sided sewers, fig. 1, and 2, have always been subject to destruction, by the lateral pressure acting in some places, with such force as to cause the sides to cave in, and choke the drain, whilst the Egg shape, fig. 3, besides offering a greater lateral resistance, has the advantage over the others, of producing less friction and thereby affording a greater velocity.

But in general, whatever may be the quality of the cement used to form the bottoms of sewers, it has proved impossible to prevent fissures through which the sewage filters and causes effluvia, sometimes undermining the sewer to such a degree, as to cause its destruction, but in all cases, these fissures form an uneven bottom which encreases the friction. However it must be admitted that each form has its own inconvenience. The flat bottoms could be improved by using flag stones, which would resist better than brick and be less liable to injury, from the excavations caused by the oozing through the fissures, but the sides would be always subject to *bulge* in; on the other hand the Egg shape or curved bottoms are subject to give way by infiltration, but will resist any pressure acting on the sides.

Now supposing that, notwithstanding the obstacles above mentioned, against brick drains, the Corporation would feel inclined to make a trial of them, in some sections of this City, your Inspector begs leave to bring into notice an objection not felt in England, but which would operate constantly in Canada ; it is a well known fact, that the frost penetrates from 3 to 4 feet into the ground, and that either for the operation of the gas, or that of the Water Works, it will be impossible to prevent excavations being made during the winter season, which will expose the public sewers, as it is impossible to fill the trenches in the winter, tight enough to keep the frost from the sewers.

The consequence will be that the sewage will freeze and accumulate till it burst the drain.

But the last objection which is stronger than any of the others, is the cost of brick sewers in England. Those represented by figure 1 and 2, are estimated at £3388 per mile, or 12s 9d per running foot, and the Egg shape fig. 3, at 8s 7d per running foot, exclusive of trenching, back filling and the removing of the surplus earth, which would come to 6s more in rock, and to 1s 3d in earth.

Therefore, whatever may be the economy and the difference in the price of labour, at Quebec, for the construction of brick drains, your Inspector, in his humble opinion, doubts that your Council will find their cost sufficiently low, to justify the adoption of their construction, in Quebec, on a large scale.

Your Inspector, confident of having fully developped the inconveniences which would result by the intro-

duction of brick sewers, in Quebec, will endeavour to show that the system of wooden drains, followed up hitherto, may with some few modifications, be continued ; It being the most economical and the more suitable to the means of the city.

It may however be worthy of consideration, whether the small drains communicating from the houses, with the sewers, should be constructed with earthen pipes, but this subject will be considered hereafter.

The timber used hitherto, for the sides of sewers, was 4 inch white pine plank, from 18 to 24 inches broad. The 24 inch planks were generally used single, but those of 18 inches, two or three pieces together, for sewers of 3 feet and 4½ feet high.

The quality of this timber is such, that it will stand a very longtime under ground and retain its soundness, particularly the 24 inch pieces, none of which have been renewed since they were put down, within the recollection of your surveyor. But the 18 inch pieces, used 2 and sometimes 3 pieces together, only jointed with pegs, in old times, have all caved in, and from some cause or other, have decayed. By the present mode of constructing the sides of sewers with more than one piece, by using uprights inside, a system, which has been followed for nearly 20 years, the timber has remained sound.

The bottoms consist of inch pine boards, and the covers of cedar, tamarac or Hemlock, and in this manner, sewers may last 50 years, or at any rate, they may last long enough to justify the cost of making them.

But the efficacy of sewers does not always depend

on the quality of the materials used in their construction; A method must be adopted to obviate all the accidents to which long levels are exposed, where it is difficult to obtain a sufficient slope to carry the sewage away.

In England they have resorted to flushings; an operation which has fully compensated for the construction of the valves and the keeping of them in operation; and your surveyor is of opinion that it would be indispensable to introduce this system for St. Rochs, where the ground is almost a dead level, by the method to be detailed hereafter.

With regard to the alterations to be made to the present wooden drains, to render them more serviceable than heretofore, it must first be considered, that it is theoretically admitted and practically proved, that the velocity of water increases in proportion to the quantity, and that this velocity is affected by the greater or lesser friction.

Now the curve line, fig. 2, will offer less friction than the square, fig. 1, so that the water which will run in a drain of the shape approaching that of fig. 2, will acquire more velocity than by passing through a square box, fig. 1; wherefore, it is of the greatest importance to adopt a method of constructing wooden drains, which will in shape, approach or assimilate to the curve represented by fig. 2. The wooden models respectfully presented herewith, constructed from fig. 6, appear to your surveyor, to fulfill those conditions.

By inspection it will appear that by fixing one 12 inch board at bottom, and one in each of the sides, the bottom of the drain is reduced to 8 inches, and by cal-

culatation it is proved that the friction is diminished 1-7th and the velocity augmented in proportion.

The greater the velocity, the less the liability of choking ; therefore precautions ought to be taken, in the construction of drains, to diminish the friction, thereby to encrease the velocity. It was found out here, as in England, that the choking of sewers occurred principally when the Junctions were made at right angles ; to obviate which, these junctions were made in England, by a curve of a radius varying from 5 to 20 feet, fig. 7 : But here, in Quebec, on using planks, the angle of 45° degrees was adopted, and has produced the same result, fig. 8. For this operation, however, it will be necessary to make a separate excavation at the corner of streets, in as much as the water pipes will join at right angles.

The choking of drains having always been, in England, the subject of minute and assiduous inquiries, a plan was at last adopted, which succeeded beyond the most sanguine expectations. It is the system of " flushing" already mentioned, and it may not be irrelevant to copy an extract of the evidence given before the metropolitan sanitary commissioners of inquiry, into the state of large Towns and populous districts, in England, by B. Williams esquire, professor of Geodesy to the college of Civil Engineers, at Putney ; 1st Report, art, 5840, where he says. " Considering the " subject of accumulation of deposits in sewers, a part " from their supposed noxious influence on the health, " there would be a considerable saving, by adopting " the system of flushing. The Tower Hamlets and " the Surrey and Kent commissions have availed " themselves of a modified system of flushing in the

“ sewers contiguous to the Thames, and it is only
 “ surprising that the benefits which the Districts are
 “ reported to have derived from the plan, when adopted
 “ without all the requisite appliances for perfect means,
 “ should not have suggested the expediency of adop-
 “ ting the plan over the entire districts. For, in the
 “ Surrey and Kent commission, it has been found that
 “ in some cases there has been no need, in conse-
 “ quence, of general casting for the last eleven years.”

The simplest mode of construction, is by fixing a flap at the extremity of each sewer connected with the river: It acts now in this way; as the tide rises the flaps are closed, and the water is penned back until the ebb removes the pressure.

This is found beneficial, but it would undoubtedly be better if the rush of the street were made instantaneous. This might be obtained by fastening the flap as the tide rises, and letting it loose when the tide has fallen to the lower edge of the sewer.

This system of flushing is by no means the best, and in England they have applied another, which has proved to be far superior; It is to construct Dams or *reservoirs* at the origin of the sewers, that is to say,—at the point where they receive the waters of high lands, and by letting the water out of these Dams, periodically, it will by its great velocity sweep the sewer clean of all the sewage which might have accumulated. These Dams can be built cheap, and they will at all times keep the sewers free from any accumulation of sewage, creating thereby an economy, not only in the dispensation of cleaning the sewers, but also in the saving on the refitting of the streets.

Let us now consider what might be the proper steps to be adopted, to carry out the views of the Council, in the drainage of the City. It would in the first place be indispensable that the lots, privies, cesspools and cellars be drained into the sewers; without which precaution, it will be difficult, if not impossible, to produce hydraulic height enough to create a sufficient velocity in the lower Districts, wherefore the deposits will accumulate and choke the sewers, particularly those of the 3rd class, whose flushing will depend chiefly on rain water and the waste water of houses.

It will also be necessary to make the citizens to understand, that the spouts of their houses should be conducted into the privies and cesspools, in order to keep them at all times free from soil, and that the expense thereof, as also that of constructing the private drain from their back premises into the sewer, should be borne by them.

No doubt but after water is introduced into the City, a good portion of the citizens will place closets in their houses, and by this means will supply the sewers during winter. But the generality will not be able to afford them, and it will become imperious with the Corporation to establish a proper *surveillance* over this class, in order that the sinks fixed out doors, be kept free from frost. It requires attention, but it can be done, in fact it is done in several places in this City, and your Surveyor, for one, has never failed in this respect, to force his servants to keep the sink of his house free, every winter.

Your surveyor, however, apprehend that it will be difficult to compel the citizens to this duty, unless a person be appointed in each ward, during winter, to

see the By-Law carried into execution ; otherwise the private drains will freeze, and the premises be flooded in the spring.

However, your Inspector would suggest that, with the view to obtain uniformity and to prevent the tearing up of the sewers, the portion of the private drains leading from the houses into the sewer, should be constructed by the Corporation and charged to the proprietor. It would not only be an economical mode, but it would also tend to relieve the public sooner from the obstructions created by such excavation.

These private drains should be constructed with 3 inch deals and their estimated cost is 1s per running foot. Supposing that burnt clay pipes could be procured in the Country, their cost would not be under 1s per running foot, exclusive of excavation, or 1s 6d complete, in earth, and 6s in rock.

Your Surveyor begs here to bring into notice a circumstance which has been and will remain a source of great inconvenience, if not remedied : It is contained in his report to the board of health, of the 13th August 1849, of which this an extract. “ When a sewer can
“ only be available to one side of the street, as it generally occurs in the Upper Town and St. John’s Ward,
“ the opposite side being lower than the sewer, has no
“ means of drainage except through his neighbour’s property, fronting on the other street, but in most cases this
“ permission is refused, whatever may be the compensation offered.”

It is evident that this difficulty, unless remedied by a law, would shackle the operations of drain-

age, and your Surveyor begs leave to suggest that an early application be made to the Legislature, to have an act passed, enacting that these matters shall be settled by arbitration, when the parties can not arrange matters amicably.

The features of the ground in the Upper Town and in St. John's ward, is such by its elevated position, that sewers and drains will keep clean without using artificial means. But in St. Rochs and the Lower Town, the want of declivity will compell a resort to those means. Seeing however that the Engineers who where examined before the commissionners aforesaid, all agree that the cleaning of Sewers, by sending men into them, with wheel Barrows, was "a monstrous evil" which should be stopped, in as much as the system of flushing is sufficient to clean them, your surveyor is of opinion that the dimensions of sewers ought to be calculated on the quantity of water which is supposed to pass through them, rather than with the view to send men in, to clean them. Therefore, sewers should not be under 18 inches, nor above 36 inches wide, by from 24 to 54 inches high, as the case may happen.

All the sewers ought, as much as practicable, to be placed in the center of the street, and at a sufficient depth that the bottom of the water pipes may be safely fixed on a level with the top of the sewers, without any risk of freezing; and this excavation will average 8 feet by from $4\frac{1}{2}$ to 6 feet.

With regard to surface water, it appears from experience, that it is preferable to faciliate its exit through the water courses, along the foot ways, than to permit it to

enter in the gratings, as heretofore. For independent of the gratings being often the cause of choking the sewer, the effluvia arising from them is extremely offensive and unhealthy.

The system of self acting traps, in the form of a dish, was tried in England, but was found so difficulty to keep in repair and of so little service that it was abandoned as not justifying the expense of construction. Your Surveyor is therefore of opinion, that the system of gratings should only be resorted to, in extreme cases.

Your Surveyor confident of having sufficiently developed the mode of constructing drains, followed in England, and of having evidently demonstrated that wooden drains were preferable for Quebec, begs to present the estimate of the latter. This estimate is made for the entire excavation and the construction of the sewers, including the excavation for water pipes, and by subtracting therefrom Mr. Baldwin's estimate for trenching, the difference will show the probable cost of draining the City, which will appear to be about £17000.

The sewers are divided into 4 classes, viz :

1st class	54 x 36 inches.	in wharves,
2nd "	36 x 24 "	main sewers,
3rd "	24 x 18 "	" transverse,
4th "	12 x 9 "	" Private drains.

The streets in which main sewers will be required are,

St. Dominique,	Street
Craig,	"
Crown,	"

Dorchester,	Street
Caron,	"
St. Ours.	"

Another main of the 2nd class should be constructed in Arago street, to receive the waters from the cliff; It will discharge in part, into Turgeon street, and thence into St. Valier and St. Ours streets.

Another part will discharge thro' Alexander, Colomb, Neilson, St. Valier and Caron streets, and finally, its western extremity will drain into St. Ours street.

Another of the same class in St. John street, without, to discharge in Ste. Geneviève and Glacis streets, at foot of which a Dam should be constructed.

Another in Latourelle street, to discharge through Ste. Geneviève street and côte d'Abraham, where another dam should be constructed, and thence into Caron street.

Another in St. John street within from d'Auteuil street to Palace street; Thence along Palace and St. Nicholas streets, and thro' St. Paul street, to the 1st class sewer, already constructed in the St. Paul's market wharf.

Another in Mountain street through Des Sœurs street to the river. Finally another through Fabrique street, Collins street and thro' the Hotel-Dieu property, to Palace street.

All the other sewers of the City will be of the 3rd class, with the exception of those traversing wharves, which will be of the 1st class.

ESTIMATION.

Excavation, Rock	84127 feet @ 6s	25238	2	0
“ earth	104252 “ “ 9d	3909	9	0
Removing “	146517 Ld. “ 4d	2441	19	0
Planks 18x4, 2c class	336508 feet “ 3d	4206	7	0
“ 24x4, 3c “	208504 “ “ 4d	3775	1	4
Deals for sleepers,	12000			
“ “ uprights	2000			
	14000 ft. @ £36	504	0	0
Boards for bottoms	50000 “ 20	1000	0	0
Cdar &c. for covers	188379 ft. “ 2d	1569	15	6
Nails 14 lbs. 350 m	5s	87	0	0
Nails 56 lbs. 80 m	20s	80	0	0
Construction	188379 ft. 2d	1569	15	6
Engineering & unforceng expences, 7 p. ct.		3106	17	5
		Total	£47488	16 9

The estimated cost of service drains of the 4th class is, 1s per foot, if constructed with 3 inch deals; But if made with earthen pipes, even on using the smallest diameter possible, say 4 inches, the lowest price would be 1s 6d in the earth, and those of 6 inches, 2s per running foot. However if this portion of the service drains, which will be constructed by the Corporation for the account of the proprietors, averaging about 18 feet in length, was done with earthen pipes, they should be continued through the back premises with the same materials, which would be impossible, considering the means of the proprietors generally. Besides those proprietors desirous of using earthen pipes, may conveniently introduce them in the wooden drains, and therefore the only practicable mode for service drains is the construction of wooden ones.

This last item would amount to	£	9418	19	0
Together with that of the sewers		17000	0	0

Will form a sum of £26418 19 0

Say, in a round sum £26500, the interest of which would come to £1590: And as it will become necessary to create a fund to extinguish the debt, and also the interest, let us suppose that a sinking fund of £1000 yearly, be created to extinguish the debt in $26\frac{1}{2}$ years, and when added to the interest, £1590, will form a sum of £2590 to be levied by assesment, amounting to about 3d in the pound additional, during that time.

But should your Council deem it expedient to cause the proprietor to reimburse the cost of his private drain forthwith, then the drain rate would be reduced to 2d in the pound, for 25 years.

The whole nevertheless respectfully submitted,

JOS. HAMEL,
Road Surveyor.



Fig. 3.

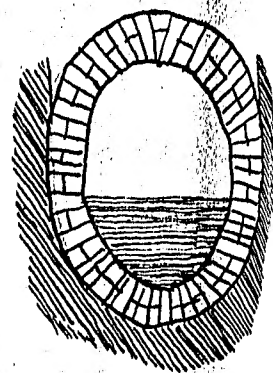


Fig. 1.

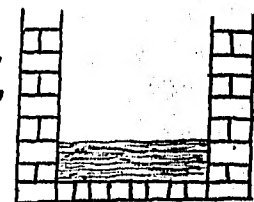


Fig. 2.

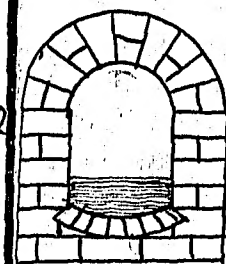


Fig. 4.

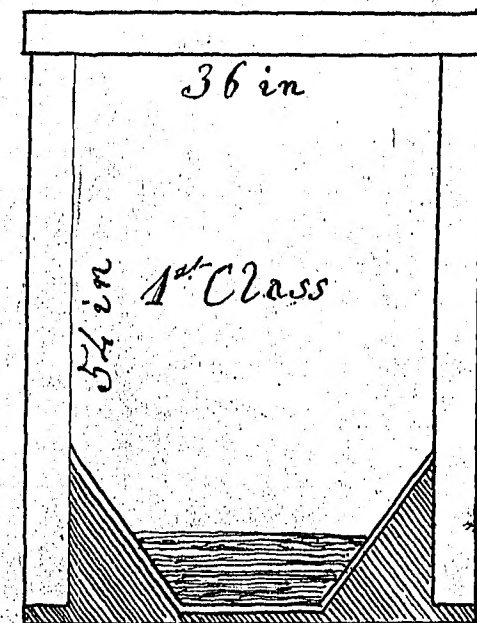


Fig. 5.

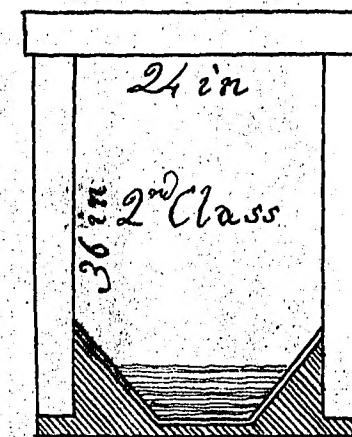


Fig. 7.

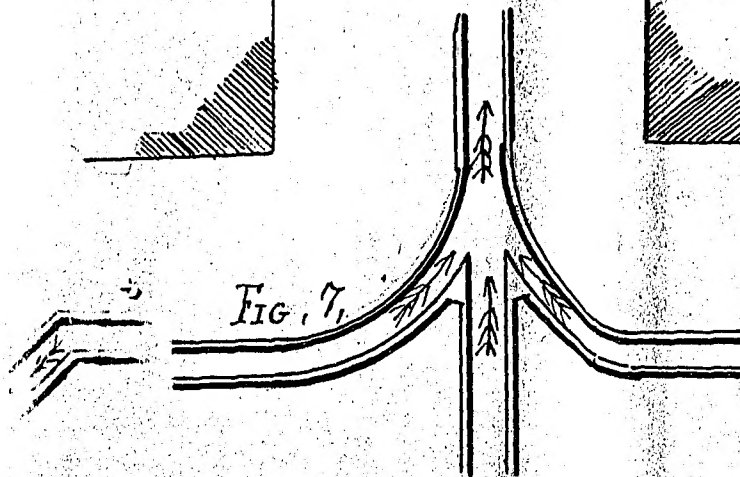


Fig. 8.

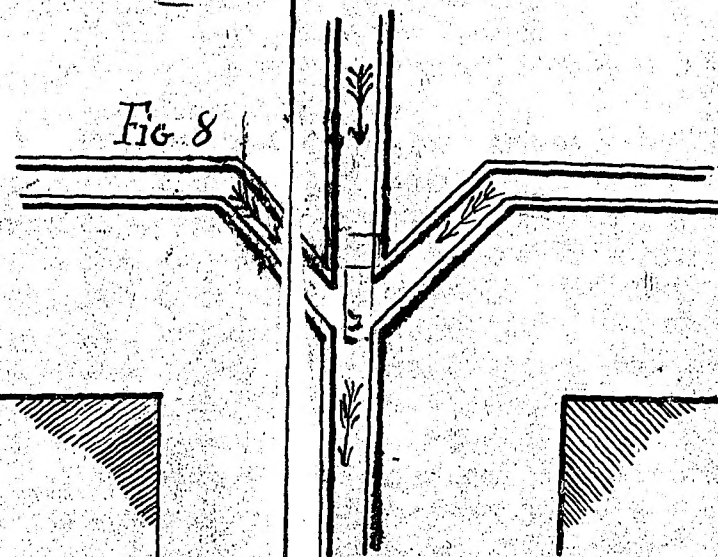


Fig. 6.

